



## General

### Guideline Title

Radiographic assessment. In: Guidelines for the management of acute cervical spine and spinal cord injuries.

### Bibliographic Source(s)

Ryken TC, Hadley MN, Walters BC, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Rozzelle CJ, Theodore N. Radiographic assessment. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):54-72. [85 references]  
[PubMed](#)

### Guideline Status

This is the current release of the guideline.

## Recommendations

### Major Recommendations

The rating schemes used for the strength of the evidence (Class I-III) and the levels of recommendations (Level I-III) are defined at the end of the "Major Recommendations" field.

#### Recommendations

##### Awake Asymptomatic Patient

###### *Level I*

- In the awake, asymptomatic patient who is without neck pain or tenderness, who has a normal neurological examination, is without an injury detracting from an accurate evaluation, and who is able to complete a functional range of motion examination; radiographic evaluation of the cervical spine is not recommended.
- Discontinuance of cervical immobilization for these patients is recommended without cervical spinal imaging.

##### Awake Symptomatic Patient

###### *Level I*

- In the awake, symptomatic patient, high-quality computed tomography (CT) imaging of the cervical spine is recommended.
- If high-quality CT imaging is available, routine 3-view cervical spine radiographs (CSRs) are not recommended.
- If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended.  
This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well

visualized on the plain cervical x-rays.

### *Level III*

- In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered:
  1. Continue cervical immobilization until asymptomatic.
  2. Discontinue cervical immobilization following normal and adequate dynamic flexion/extension radiographs.
  3. Discontinue cervical immobilization following a normal magnetic resonance image (MRI) obtained within 48 hours of injury (limited and conflicting Class II and Class III medical evidence).
  4. Discontinue cervical immobilization at the discretion of the treating physician.

### Obtunded or Unevaluable Patient

#### *Level I*

- In the obtunded or unevaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice. If CT imaging is available, routine 3-view CSRs are not recommended.
- If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical x-rays.

#### *Level II*

- In patients in whom there is a high clinical suspicion of injury yet have a normal high-quality CT imaging study, it is recommended that the decisions for further patient management involve physicians trained in the diagnosis and management of spinal injuries.

#### *Level III*

- In the obtunded or unevaluable patient with a normal high-quality CT or normal 3-view cervical spine series, the following recommendations should be considered:
  1. Continue cervical immobilization until asymptomatic.
  2. Discontinue cervical immobilization following a normal MRI study obtained within 48 hours of injury, (limited and conflicting Class II and Class III medical evidence).
  3. Discontinue cervical immobilization at the discretion of the treating physician.
- In the obtunded or unevaluable patient with a normal high-quality CT, the routine use of dynamic imaging appears to be of marginal benefit and is not recommended.

### Summary

#### Awake Asymptomatic Patient

Class I medical evidence was previously reported on this topic. The current updated review identified additional Class I evidence supporting a Level I recommendation that in the awake, asymptomatic patient who is without neck pain or tenderness, is neurologically intact without an injury detracting from an accurate evaluation, and who is able to complete a functional range of motion examination, radiographic evaluation of the cervical spine is not recommended. The discontinuance of cervical immobilization in this patient population is recommended.

#### Awake Symptomatic Patient

Class I medical evidence was previously reported on this topic. This current updated review identified additional Class I medical evidence that alters the previous Level I recommendation. High-quality CT imaging of the cervical spine in the symptomatic trauma patient has been proven to be more accurate than CSRs with higher sensitivity and specificity for injury following blunt trauma. If high-quality CT is available, 3-view CSRs are not necessary. If high quality CT is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) remains a Level I recommendation.

The question of "what to do?" if anything for the awake patient with neck pain or tenderness and normal high-quality CT or 3-view CSR remains less clear. Only lower level medical evidence is available to guide treatment decisions for these patients. The current literature offers less robust medical evidence in support of the 3 following strategies in the awake but symptomatic patient: (1) continue cervical immobilization until asymptomatic, (2) discontinue cervical immobilization following either normal and adequate dynamic flexion/extension radiographs, or a normal

MRI study obtained within 48 hours of injury, or (3) discontinue immobilization at the discretion of the treating physician. Several studies favor the use of MRI (Level II) over dynamic radiographs (Level III) in further study of these patients, but may not be feasible or indicated in all situations.

#### Obtunded or Unevaluable Patient

A large number of studies have been produced since the previous guideline publication on imaging the obtunded or unevaluable patient in order to clear the cervical spine without the benefit of the clinical examination. The current Level I recommendation, based on Class I medical evidence, is that high-quality CT imaging is recommended as the initial imaging study of choice. If high-quality CT imaging is available, routine 3-view CSRs are not necessary, similar to the Level I recommendations in the other categories. If high-quality CT is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. The plain cervical spine x-ray studies should be supplemented with CT (when it becomes available) if necessary, to further define areas that are suspicious or not well-visualized on the plain cervical x-rays.

The most controversial issue in the obtunded/unevaluable patient group is the recommendation on the discontinuation of immobilization. The current recommendation is that in the obtunded or unevaluable patient who has normal high-quality CT imaging or a normal 3-view cervical spine series, 1 of the following strategies be considered: (1) continue cervical immobilization until asymptomatic, (2) discontinue cervical immobilization following a normal MRI study obtained within 48 hours of injury, or (3) discontinue immobilization at the discretion of the treating physician. MRI appears to be the imaging modality of choice in this situation based on limited and conflicting Class II and Class III medical evidence. Class III medical evidence suggests that the routine use of dynamic imaging is of marginal benefit and is not recommended. Class II medical evidence suggests that the decisions for the subsequent patient management of the obtunded/unevaluable patient including whether or not to obtain an MRI study on individual patients involve physicians trained in the diagnosis and management of spinal injuries.

#### Definitions:

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question<sup>a</sup>

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
I	High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\bar{A}$ , statistic $\geq 0.60$ or an intraclass correlation coefficient of $\geq 0.70$
	Systematic review <sup>b</sup> of Class I randomized controlled trials (and study results were homogeneous <sup>c</sup> )	Systematic review <sup>b</sup> of Class I studies	
II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization)	Development of diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\bar{A}$ , statistic of 0.40–0.60 or an intraclass correlation coefficient of 0.50–0.70
	Prospective <sup>d</sup> comparative study <sup>e</sup>	Systematic review <sup>b</sup> of Class II studies	
	Systematic review <sup>b</sup> of Class II studies or Class I studies with inconsistent results	Study of nonconsecutive patients; without consistently applied reference "gold" standard	
	Case-control study <sup>g</sup>	Systematic review <sup>b</sup> of Class III studies	
	Retrospective <sup>f</sup> comparative study <sup>e</sup>	Case-control study	

Class III	Systematic review <sup>b</sup> of Class II studies Therapeutic Studies: Investigating the Results of Treatment Case series <sup>b</sup>	Diagnostic Studies: Investigating a Diagnostic Test Poor reference standard	Clinical Assessment: Studies of Reliability and Validity of Observations, including Clinical Examination, Imaging Results, and Classifications Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\bar{\kappa}$ statistic of $<0.40$ or an intraclass correlation coefficient of $<0.50$
	Expert opinion	Expert opinion	

<sup>a</sup>A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.

<sup>b</sup>A combination of results from 2 or more prior studies.

<sup>c</sup>Studies provided consistent results.

<sup>d</sup>Study was started before the first patient enrolled.

<sup>e</sup>Patients treated 1 way (e.g., halo vest orthosis) compared with a group of patients treated in another way (e.g., internal fixation) at the same institution.

<sup>f</sup>The study was started after the first patient was enrolled.

<sup>g</sup>Patients identified for the study on the basis of their outcome, called "cases" (e.g., failed fusion), are compared with those who did not have outcome, called "controls" (e.g., successful fusion).

<sup>h</sup>Patients treated 1 way with no comparison group of patients treated in another way.

#### Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
Level III	Other strategies for patient management for which the clinical utility is uncertain (inconclusive or conflicting evidence or opinion)

## Clinical Algorithm(s)

None provided

## Scope

## Disease/Condition(s)

Acute cervical spine and spinal cord injuries

## Guideline Category

Evaluation

Management

## Clinical Specialty

Emergency Medicine

Neurological Surgery

Neurology

Orthopedic Surgery

Radiology

## Intended Users

Advanced Practice Nurses

Hospitals

Physician Assistants

Physicians

## Guideline Objective(s)

To build on the foundation of previously published evidence-based guidelines on the topic of imaging the cervical spine following acute blunt trauma, adding pertinent new evidence on the issues generated over the past decade

## Target Population

Patients with cervical spine and spinal cord injuries

- Awake, asymptomatic patients
- Awake, symptomatic patients
- Obtunded or unevaluable patients

## Interventions and Practices Considered

1. Radiographic evaluation of the cervical spine
2. High-quality computed tomography (CT) imaging of the cervical spine
3. Three-view cervical spine series (anteroposterior, lateral, and odontoid views)
4. Magnetic resonance imaging (MRI) of the cervical spine
5. Discontinuation or continuation of cervical immobilization based on imaging results

## Major Outcomes Considered

- Sensitivity and specificity of imaging studies
- Negative and positive predictive values of imaging studies

## Methodology

## Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

## Description of Methods Used to Collect/Select the Evidence

### Search Criteria

A computerized search of the database of the National Library of Medicine (PubMed) between 1966 and 2011 was conducted using the search terms "spinal cord injury" or "spinal fractures" or "spinal injuries" and resulted in 30,238 references. A similar search was conducted with search terms "clearance" or "diagnosis" or "radiographs" that provided 23,005,577 citations. Combining these 2 searches using "and" gave 6,399 references. The search was limited to the English language and human subjects. This resulted in 4,942 citations. The titles and abstracts of these references were reviewed. Studies that investigated the diagnostic potential of an imaging technique to assess cervical trauma were selected. Additional articles were obtained from the bibliographies of selected manuscripts. Thirty-two manuscripts were identified that provided either direct or supporting medical evidence on the diagnostic potential of cervical spinal imaging modalities. In general, priority was given to large (>100 patients) prospective studies, meta-analyses, and articles published since the previous iteration of this guideline.

## Number of Source Documents

Fifteen articles addressing cervical spinal imaging in asymptomatic trauma patients, 25 references addressing imaging in symptomatic patients, and 20 references addressing imaging in the obtunded patient are summarized in Evidentiary Table format (refer to Tables 3 to 5 in the original guideline document).

## Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

## Rating Scheme for the Strength of the Evidence

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question<sup>a</sup>

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
I	High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\bar{A}$ , statistic $\geq 0.60$ or an intraclass correlation coefficient of $\geq 0.70$
	Systematic review <sup>b</sup> of Class I randomized controlled trials (and study results were homogeneous <sup>c</sup> )	Systematic review <sup>b</sup> of Class I studies	
II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization)	Development of diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\bar{A}$ , statistic of 0.40–0.60 or an intraclass correlation coefficient of 0.50–0.70

Class	Therapeutic Studies: Investigating the Prospective <sup>d</sup> comparative study <sup>e</sup> Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test studies	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
	Systematic review <sup>b</sup> of Class II studies or Class I studies with inconsistent results	Study of nonconsecutive patients; without consistently applied reference "gold" standard	
	Case-control study <sup>g</sup>	Systematic review <sup>b</sup> of Class III studies	
	Retrospective <sup>f</sup> comparative study <sup>e</sup>	Case-control study	
	Systematic review <sup>b</sup> of Class II studies		
III	Case series <sup>h</sup>	Poor reference standard	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a $\kappa$ statistic of $<0.40$ or an intraclass correlation coefficient of $<0.50$
	Expert opinion	Expert opinion	

<sup>a</sup>A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.

<sup>b</sup>A combination of results from 2 or more prior studies.

<sup>c</sup>Studies provided consistent results.

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<sup>h</sup>Patients treated 1 way with no comparison group of patients treated in another way.

## Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

## Description of the Methods Used to Analyze the Evidence

Selected articles were carefully reviewed by the authors. Evidentiary tables were created (refer to Tables 3 to 5 in the original guideline document) that reflected the strengths and weaknesses of each article.

On occasion, the assessed quality of the study design was so contentious and the conclusions so uncertain that the guideline authors assigned a lower medical evidence classification than might have been expected without such a detailed review. In every way, adherence to the Institute of Medicine's criteria for searching, assembling, evaluating, and weighing the available medical evidence and linking it to the strength of the recommendations presented in this document was carried out.

Articles that did not achieve immediate consensus among the author group were discussed extensively until a consensus was reached. Very few contributions required extensive discussion. Most articles were easily designated as containing Class I, II, or III medical evidence using the criteria set forth by the author group at the initiation of the literature evaluation process (see the "Rating Scheme for the Strength of the Evidence" field).

## Methods Used to Formulate the Recommendations

Expert Consensus

## Description of Methods Used to Formulate the Recommendations

The current author group was selected for its expertise in spinal surgery (both neurosurgical and orthopedic), neurotrauma, clinical epidemiology, and, in several cases, prior experience with guideline development. The topics chosen for inclusion in this iteration of these guidelines are contemporary and pertinent to the assessment, evaluation, care, and treatment of patients with acute cervical spine and/or spinal cord injuries.

## Rating Scheme for the Strength of the Recommendations

Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
Level III	Other strategies for patient management for which the clinical utility is uncertain (inconclusive or conflicting evidence or opinion)

## Cost Analysis

Published cost analyses were reviewed.

## Method of Guideline Validation

Not stated

## Description of Method of Guideline Validation

Not applicable

## Evidence Supporting the Recommendations

### Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

## Benefits/Harms of Implementing the Guideline Recommendations



## Potential Benefits

Accurate radiographic assessment of patients with acute cervical spine and spinal cord injuries to aid subsequent patient management decisions, including discontinuation of cervical immobilization

## Potential Harms

False-positive and false-negative imaging results

## Qualifying Statements

### Qualifying Statements

- Medical evidence-based guidelines are not meant to be restrictive or to limit a clinician's practice. They chronicle multiple successful treatment options (for example) and stratify the more successful and the less successful strategies based on scientific merit. They are not absolute, "must be followed" rules. This process may identify the most valid and reliable imaging strategy for a given injury, for example, but because of regional or institutional resources, or patient co-morbidity, that particular imaging strategy may not be possible for a patient with that injury. Alternative acceptable imaging options may be more practical or applicable in this hypothetical circumstance.
- Guidelines documents are not tools to be used by external agencies to measure or control the care provided by clinicians. They are not medical-legal instruments or a "set of certainties" that must be followed in the assessment or treatment of the individual pathology in the individual patients we treat. While a powerful and comprehensive resource tool, guidelines and the recommendations contained therein do not necessarily represent "the answer" for the medical and surgical dilemmas faced with many patients.

## Implementation of the Guideline

### Description of Implementation Strategy

An implementation strategy was not provided.

### Implementation Tools

Mobile Device Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

## Institute of Medicine (IOM) National Healthcare Quality Report Categories

### IOM Care Need

Getting Better

### IOM Domain

Effectiveness

# Identifying Information and Availability

## Bibliographic Source(s)

Ryken TC, Hadley MN, Walters BC, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Rozzelle CJ, Theodore N. Radiographic assessment. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):54-72. [85 references]  
[PubMed](#)

## Adaptation

Not applicable: The guideline was not adapted from another source.

## Date Released

2013 Mar

## Guideline Developer(s)

American Association of Neurological Surgeons - Medical Specialty Society

Congress of Neurological Surgeons - Professional Association

## Source(s) of Funding

Congress of Neurological Surgeons

## Guideline Committee

Guidelines Author Group of the Joint Section of Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons

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## Financial Disclosures/Conflicts of Interest

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this guideline.

## Guideline Status

This is the current release of the guideline.

## Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) and EPUB for eBook devices from the [Neurosurgery Web site](#)

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## Availability of Companion Documents

The following are available:

- Foreword. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):1. Electronic copies: Available in Portable Document Format (PDF) from the [Neurosurgery Web site](#) .
- Commentary. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):2-3. Electronic copies: Available in PDF from the [Neurosurgery Web site](#) .
- Introduction to the guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):5-16. Electronic copies: Available in PDF from the [Neurosurgery Web site](#) .
- Methodology of the guidelines for management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):17-21. Electronic copies: Available in PDF from the [Neurosurgery Web site](#) .

## Patient Resources

None available

## NGC Status

This NGC summary was completed by ECRI Institute on July 9, 2013. The information was verified by the guideline developer on October 3, 2013.

## Copyright Statement

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